

01

ELECTRICAL DESIGN ANALYSIS

TRANSMITTER FACILITY

STATINTL



60 % REVIEW PRINT

JAN. 22.1968

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	File

Project	Transmitter	of	17
Feature	Electrical Design Analysis	Designed	M.I.
Item	Design Analysis Summary	Checked	
		Date	18 Jan 1968

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I. GENERAL: The electrical design for Transmitter Facility [REDACTED] covers Transmitter Building and Gate House including the installation of government furnished 200 KW diesel engine driven generator sets with switchgear; interior work including power, lighting, control, grounding system, fire alarm, and outlets, conduit, terminal cabinet, cable tray and floor trench system for telephone, intercommunication and technical equipment wiring by others; and exterior work including extension to existing primary power distribution, protective lighting, secondary power service to Gate House and provisions of duct sleeves under roads and paved area for antenna cables by others.

II. DESIGN CRITERIA:

a. Request for Proposal on Design, P00GM letter of 15 March 1966 with the following attachments:

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1. Using Agency Sketch Drawings:

No drawing number	[REDACTED]
Dwg. No. D5345-T/D-01,	Interior Grounding
Dwg. No. D5020-T/D-01,	Exterior Grounding
Dwg. No. D5341.02-T/F-01,	Floor Plan
Dwg. No. D5345-T/CL-01,	Plot Plan, Transmitter Site
Dwg. No. D5345-T/E-01,	Bus Duct & Power Panel Locations
No drawing number	Government Furnished Electrical Equipment

2. Scope of Work.

3. POD Comments on the Scope of Work, dated March 1966.

4. Description and Analysis of Electrical System (System 5).

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- b. Scope of Work attached to and made a part of Contract No.

- c. Using Agency Information, Ref: POOGM letter of 9 April 1966 with the followings:

1. T.M.C. Power Distribution, Inc. drawings for 200 KW engine generator set,

Dwg. No. 15554-C,	Radiator Shroud & Guard
Dwg. No. 15342-C,	Lockout for Shockmounts
Dwg. No. 15587-B,	Mounting Detail
Dwg. No. 15549-B,	Battery Charger Wiring Diagram
Dwg. No. 155751-B,	Battery Charger 2412-52
Dwg. No. 15426-C,	Standard Engine Wiring Harness
Dwg. No. 15520-D,	Schematic
Dwg. No. 15770-D,	Assembly Drawing
Dwg. No. 15416-D,	Assembly Drawing
Dwg. No. 15589-D,	Storage Battery (Ordnance)
Dwg. No. 17016-D,	Wiring Diagram
Dwg. No. 15755-D,	Cabinet & Door Layout
No drawing No.	Point to Point Wiring Diagram

2. Installation and Maintenance Manual,
Granger Associates Model 747L antenna.

3. Using Agency Sketch Drawings, same drawings listed in design criteria reference a.1. plus the followings;

Dwg. No. D5345-T/S-01,	Heat Load
Dwg. No. D5345-T/S-02,	Antenna Cable Tray System
Dwg. No. D5345-T/S-03,	Transmitter/Exciter Cable Tray System
Dwg. No. D5345-T/S-04,	Signal Cable Tray System

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STATINTL d. Additional Information, Ref: POOGM letter of 18 June 1966 with the following [REDACTED] drawings.

Dwg. No. D-208316, System No. 5 SWBD Arrangement

Dwg. No. C-208290, Load Box Arrangement

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e. [REDACTED] Review Comments for 30% completion of the design.

f. Info for Facility Site change, Ref: POOGM letter of 29 November 1967.

g. Instruction Book for Rotatable Unidirectional HF Antenna 237B-3 with 2 prints for 437C-3A Antenna.

h. Data for Broad Band Dipole Antenna 437G-2A, Ref: POOGM letter of 1 December 1967.

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i. As-Built Dwgs. for [REDACTED]
[REDACTED]), reference for existing primary power line, Ref: POOGM letter of 15 December 1967.

j. Memorandum for the Record of the meeting held on 11 January 1967 with [REDACTED] Ref: Our letter of 16 January (Ref. No. C-16-68).

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k. Department of the Army Technical Manuals, TM5-811-1 and -2.

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l. Applicable [REDACTED]

m. NEC 1965.

n. IES Lighting Hand Book, 4th edition.

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III. DESIGN RESUME:

Generally, five basic design pointers were considered in the electrical system layout such as safety capacity, flexibility, accessibility and reliability.

Circuit design will conform to the requirements of the National Electrical Code.

Circuit loading is generally 20-ampere, 2-wire, 120-volt for lighting and receptacles.

In all cases, loading of circuit will not exceed 80% of the branch circuit rating.

Branch circuits and feeders overcurrent protection will be rated 25% greater than the load rating, but shall not exceed 150% of the load.

Specific rules for fuse and circuit breaker setting and coordination of the National Electrical Code will be followed.

Basic limitations on voltage drop for this design will be:

3% for feeders or sub-feeders from transformer to lighting or power panelboards.

2% for branch circuits to lighting or power loads.

Motor circuits will be 2 & 3% of the above respectively.

The number of lighting and power branch circuits will be based on the final load requirements of the building.

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Electric power will be derived from plug-in bus duct at 240 volts, 3-phase generators are GFM and will be wired for complete integration with [REDACTED]

Building utility load power will be 120/208 volts derived from a 150 KVA dry type transformer except for air conditioning equipment.

Grounding is a stringent requirement of this project. Design is prepared in accordance with the using service grounding requirements and the National Electrical Code.

There will be two separate grounding systems though it is realized that a single grounding source is generally always used for grounding both the system and equipment.

The building system neutral will be grounded at the power entrance cubicle located in the power room and tied to the transformer secondary ground.

All metal throughout the building such as reinforcing steel, steel cabinets, panelboards, antenna switches, hardware, cable shields, etc. will be physically bonded together and connected to the grounding grid or peripheral ground wire or indicated on the drawings.

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ELECTRICAL DESIGN ANALYSIS

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TRANSMITTER BUILDING



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Project TRANSMITTER of 17
Feature TRANSMITTER BUILDING Designed _____ Date _____
Item ELECTRICAL DESIGN ANALYSIS Checked _____ Date _____

LOAD & SERVICE ANALYSIS

CONNECTED LOAD : 789,786 KVA

MAX. DEMAND LOAD : 789,786 (CONN. LOAD) X 0.93 (DEMAND FACTOR) = 735.2 KVA

BLDG. DEMAND LOAD : 735.2 (MAX. DEMAND LOAD) * 1.1 (DIVERSITY FACTOR) = 668.4 KVA

SERVICE : 240 VOLTS, 3 PHASE, 3 WIRE, 60 CYCLES

SERVICE SIZES ARE DERIVED UNDER SERVICE SIZE ANALYSIS WHERE
DISTANCE FROM THE TRANSFORMER STATION IS CONSIDERED IN
CALCULATING SIZE.

INC.

Project TRANSMITTER BUILDING
 Feature TRANSMITTER BUILDING
 Item ELECTRICAL DESIGN ANALYSIS

Designed Date
 Checked Date

of 17

LOAD SCHEDULE

ITEM	LOAD DESCRIPTION	CONN. LOAD VA	DEMAND FACTOR	DEMAND LOAD-VA	USE FACTOR	USE LOAD-VA
PANEL "A"	FLUORESCENT LIGHTS	4,600	1.00	4,600		
	INCANDESCENT LIGHTS	1,610	1.00	1,610		
	RECEPTACLES	3,780	0.50	1,890		
	REFRIGERATOR	510	1.00	510		
	EXHAUST FANS	360	1.00	360		
	RANGE	10,500	0.80	8,400		
	TOASTER	2,700	0.80	2,160		
	HOT WATER HEATER	7,000	1.00	7,000		
	SPARE	4,500	0.70	3,150		
	SUB-TOTAL	35,560	0.83	29,680		
PANEL "B"	FLUORESCENT LIGHTS	11,400	1.00	11,400		
	INCANDESCENT LIGHTS	200	1.00	200		
	RECEPTACLES	3,400	0.50	1,700		
	SPARE	2,250	0.70	1,575		
	SUB-TOTAL	17,250	0.82	14,175		
PANEL "C"	INCANDESCENT LIGHTS	4,700	1.00	4,700		
	RECEPTACLES	2,160	0.50	1,080		
	ROOF VENT.	750	1.00	750		
	BATTERY CHARGERS	1,600	0.50	800		
	SPARE	3,000	0.70	2,100		
	SUB-TOTAL	11,210	0.80	8,930		
MOTOR CONTROL CENTER MCC	AIR COOLED CONDENSERS	16,200	1.00	16,200		
	CHILLED WATER CIRC. PUMPS	11,400	1.00	11,400		
	AIR HANDLING UNITS	14,820	1.00	14,820		
	DUCT HEATER	6,000	0.0**	0		
	WATER CHILLERS	11,236	1.00	11,236		
	VENT. SYSTEM	9,660	1.0	9,660		
	SUB-TOTAL	170,316	0.96	164,316		

* DEMAND FACTOR DETERMINED FEEDER SIZES

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** HEATING EQUIP. DOES NOT RUN WHEN A/C UNIT ON.

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Designed _____ Date _____

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L O A D S C H E D U L E					
ITEM	LOAD DESCRIPTION	CONN LOAD VA	DEMAND FACTOR	DEMAND LOAD-VA	
PANEL 'D'	FLOOD LIGHTS	8400	1.0	8400	
	GATE HOUSE	2000	1.0	2000	
	OBSTRUCTION LIGHTS	1700	1.0	1700	
	ANTENNA ROTATOR MOTORS	9600	0.5	4800	
	SPARE	1500	0.8	1200	
		23200	0.78	18100	
PANEL "TA"	EQUIP.	20000	1.0	20000	
PANEL "TB"	EQUIP.	8000	1.0	8000	
SWGR. 'MS'	PANEL 'A'	35560	0.83	29680	
	" 'B'	19250	0.82	15875	
	" 'C'	11210	0.80	8930	
	" 'D'	23200	0.78	18100	
	" 'TA'	20000	1.0	20000	
	" 'TB'	8000	1.0	8000	
		117220	0.86	100585	

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L O A D S C H E D U L E

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PROJECT TRANSMITTER
FEATURE TRANSMITTER
ITEM 17

DESIGNED
CHECKED

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LOCATION		REQ'D & MTD. F.C.	ROOM SIZE		CEILING & MTD. HEIGHT	ROOM INDEX	COEF. OF UT.		M.F.	REQ'D & MTD. LUMENS	NO. & SIZE OF LAMP	TYPE OF FIXTURE	
			W. X. L.	AREA			REFL.	COEF.					
OFFICE	101	75	10.6 X 13.5	143.1	8'-2"	H	75	.50	.43	.70	47,000	3/40WFL	"F-31"
LINK EQUIP- MENT ROOM	102	75	10.6 X 14	148.4	8'-2"	H	"	"	.48	.70	83,000	7.050FL	"F-411"
MAINT. SHOP	103	75	10.6 X 25.0	274.6	8'-2"	G	"	"	.51	.70	57,600	3/40WFL	"
CORRIDOR	104	20	3.2 X 52.0	169.3	8'-2"	J	"	"	.22	.65	23,600	1.450FL	"F-31"
DAY ROOM	105	33	10.6 X 10	106	8'-2"	I	"	"	.44	.70	12,200	2.050FL	"F-31"
KITCHEN	106	50	10.6 X 7.6	79.5	8'-2"	I	"	"	.44	.70	12,200	3/40WFL	"
TOILET	107	15	10.6 X 0.0	00.0	8'-2"	I	"	"	.39	.70	1,050	1.200FL	"F-31"
PARTS ROOM	108	50	10.6 X 25.3	268.2	8'-2"	G	"	"	.51	.70	27,400	3/40WFL	"F-11"
TRANSMITTER RM.	109	75	24.4 X 54.3	1,324.0	8'-6"	D	75	.50	.66	.70	215,000	2/40WFL	"F-9"
	110	33			8'-6"	D	"	"	.66	.70	42,400	4/40WFL	"NS-1"
		20.5			10'-6"	E	"	"	.61	.70	63,000	2/40WFL	"F-9"
		20.5			10'-6"	E	"	"	.61	.70	63,000	4/40WFL	"NS-1"
CONTROL ROOM	111	15	24.7 X 24.7	610.1	12'-6"	G	"	"	.53	.70	123,200	4/40WFL	"NS-1"
AIR COND. ROOM	112	15	24.7 X 25.5	620.9	12'-6"	G	"	"	.51	.65	29,400	1.200FL	"F-31"
POWER ROOM	113	15	3.1 X 17.4	53.9	12'-6"	F	"	"	.54	.65	29,400	1.200FL	"

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Feature TRANSMITTER BUILDING Designed _____ Date _____
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TRANSFORMER CAPACITY DETERMINATION

BUILDING SERVICE TRANSFORMER:

PRIMARY 13.8KV 3 ϕ 3W 60CPS
SECONDARY 240V, 3 ϕ 3W

TOTAL CONNECTED LOAD = 789.8 KVA

TOTAL DEMAND LOAD = 735 KVA, DEMAND FACTOR = 0.93

MAXIMUM DEMAND LOAD = 668 KVA, DIVERSITY FACTOR = 1.1

THEREFORE A 150KVA TRANSFORMER IS SELECTED

DRY TYPE INTERIOR DISTRIBUTION TRANSFORMER:

PRIMARY 240V, 3 ϕ 3W, 60CPS
SECONDARY 120/208V, 3 ϕ 4W

TOTAL CONNECTED LOAD = 117.2 KVA

TOTAL DEMAND LOAD = 100.6 KVA DEMAND FACTOR = 0.86

MAXIMUM DEMAND LOAD = 100.6 KVA DIVERSITY FACTOR = 1.0

A 150 KVA TRANSFORMER IS SELECTED PER CRITERIA
REFERENCE 2.4.

Project TRANSMITTER of 17
 Feature EXTERIOR UTILITY Designed M.I. Date 15 JAN. '68
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FLOODLIGHTING CALCULATIONS

CALCULATION FOR REQUIRED NUMBER & SIZE OF FLOODLIGHTS
 BASED ON "LUMENS IN THE BEAM" METHOD

$$\text{BEAM LUMENS REQUIRED} = \frac{\text{AREA IN SQ. FT.} \times \text{FT. C. REQD} \times \text{FACTOR FOR LIGHT FALLING OUTSIDE AREA}}{\text{MAINTENANCE FACTOR}}$$

BEAM LUMENS REQUIRED TABLE							
AREA DESCRIPTION	AREA	FOOT CANDLE REQUIRED	LIGHT LOSS FACTOR	MAINTENANCE FACTOR	AREA LUMENS REQUIRED	FLD. LGT. ANGLE REQUIRED	
(285' x 190')							
-(135' x 26') - (55' x 27')							
-(25' x 27') - (33' x 44') =	47028(SF)	1	1/0.75	0.75	83600	V: 73.5°	H: No Limit
TOTAL							

(*) IES-NEMA TYPE

FLOODLIGHT DATA TABLE									
DESCRIPTION	WATTS	BEAM	VERT. ANGLE TO 10%	HORIZ. ANGLE TO 10%	LAMP LUMENS	BEAM EFF.	BEAM LUMENS	NO OF FLOOD- LIGHTS	F.C. MTD.
47028 SF AREA	300	WIDE, TYPE 3(*)	91°	96°	5900	52.1%	3075	28	1.02
TOTAL									

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ELECTRICAL DESIGN ANALYSIS

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GATE HOUSE



Project TRANSMITTER of 17
 Feature GATE HOUSE Designed Date
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LOAD & SERVICE ANALYSIS

CONNECTED LOAD : 2.0 KVA

MAX. DEMAND LOAD : $\frac{2.000}{(\text{CONN. LOAD})} \times \frac{1.0}{(\text{DEMAND FACTOR})} = 2.0$ KVA

BLDG. DEMAND LOAD : $\frac{2.0}{(\text{MAX. DEMAND LOAD})} \div \frac{1.0}{(\text{DIVERSITY FACTOR})} = 2.0$ KVA

SERVICE : 120/208 VOLTS, 1 PHASE, 3 WIRE, 60 CYCLES

SERVICE SIZES ARE DERIVED UNDER SERVICE SIZE ANALYSIS WHERE
 DISTANCE FROM THE TRANSFORMER STATION IS CONSIDERED IN
 CALCULATING SIZE.

LIGHTING REQUIREMENTS

$$\frac{\text{REQ'D F.C. X AREA}}{\text{REQ'D LUMENS}} = \text{COEF. X M.F.}$$